WHAT DO NECTARIS BASIN IMPACT MELT ROCKS LOOK LIKE AND WHERE CAN WE FIND THEM? B. A. Cohen[1], N. E. Petro[2], and S. J. Lawrence[3]; [1]NASA Marshall Space Flight Center, Huntsville AL 35812 (Barbara.A.Cohen@nasa.gov), [2]NASA Goddard Space Flight Center, Greenbelt MD 20771; [3]School of Earth and Space Exploration, Arizona State University, Tempe AZ 85281.

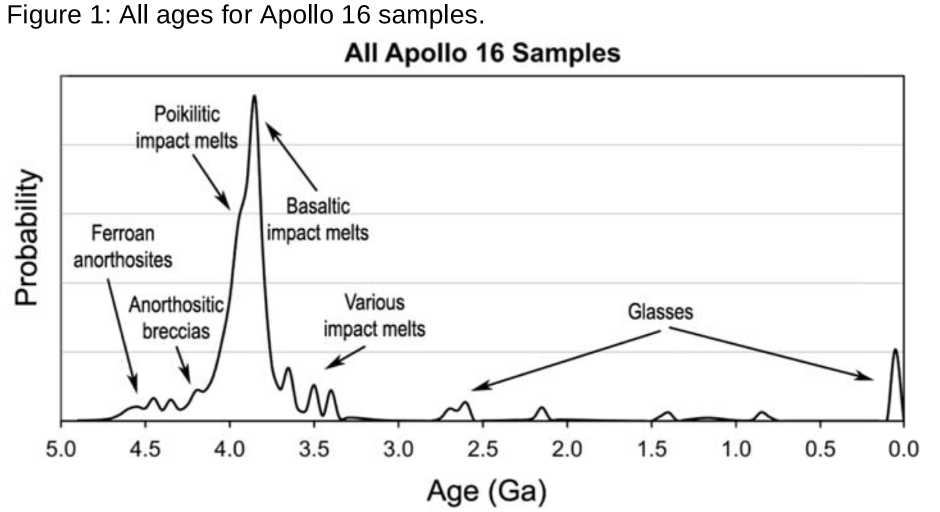
Introduction: The formation of the Nectaris basin is a key event defining the stratigraphy of the Moon. Its absolute age, therefore, is a linchpin for lunar bombardment history. Fernandes et al. [1] gave a thorough account of the history of different samples thought to originate in Nectaris, with the upshot being there is little agreement on what samples represent Nectaris, if any. We are revisiting the effort to identify Nectaris basin impact-melt rocks at the Apollo 16 site, to model their emplacement, and to use these parameters to examine other sites where Nectaris impact melt is more abundant and/or more recognizable for potential further study.

Nectaris melt in Apollo 16 soil? A compendium of all the rocks so far dated (only a fraction of all possible samples) from the Apollo 16 collection is shown in Fig. 1. Though it reflects our known bias as a community toward dating radiogenic-rich, mafic impact-melt rocks, it does show several important features: a clear time of crystallization of lunar crustal rocks, represented by the abundant (though undersampled) ferroan anorthosites; a small group of ~4.1-4.2 Ga samples as noted by [1]; two distinct groups of impact-melt samples clustered ~3.95 and ~3.85 Ga; a tail off of assorted impact-melt compositions similar to the lunar meteorite ages [2]; and a handful of glassy materials spanning time until present.

At the Apollo 16 site, the formation of the Imbrium basin was undoubtedly the last major modification to the surface, forming the Cayley plains and possibly also the Descartes formation [3]. However, as the largest, it would also have the greatest depth of mixing, dredging up and mixing with material deposited by all previous impacts. We are using an updated regolith ejecta and melt model [4-6] to better constrain the amount of impact-melted material in the ejecta from successive basins contributing to the Apollo 16 regolith. Our preliminary results are shown in Fig. 2 (top), where Imbrium and Serenitatis ejecta make up the majority of the basin impact melt at the Apollo 16 surface, but a significant amount of Nectaris melt should also be present. However, since each ejecta emplacement event mixes and dilutes previous material, we are also trying to understand mixing and dilution with each successive ejecta blanket (Fig. 2 bottom). We will take this work further, constraining it with observations that mafic impact melt-breccias make up about ~29% of the Apollo 16 impact samples [7].

The Nectaris impact exhumed material from up to 45 km depth [8], which is probably not deep enough to excavate a KREEP layer, if it existed at the time of Nectaris basin formation., but may be enough to incorporate a noritic lower crustal component [9], along with a significant anorthositic component from the upper crust. Given that there is no PKT-compositional “halo” around Nectaris, we can infer that Nectaris basin impact melt is very likely not KREEPY, and instead should be quite aluminous and possibly iron-rich.

Figure 1: All ages for Apollo 16 samples.



Aluminous Group 3 samples [7] are among the youngest group based on their Ar-Ar ages [10], not predating the KREEP-rich poikilitic impact melts which are taken as Imbrium melt. Group 4 samples (low KREEP) are a logical alternative. These anorthositic impact-melt breccias have older Ar ages. [11], but a variety of textures including some described as “fragment laden,” which may have old ages due to incomplete

outgassing. More work can be done to correlate these samples with their isotopic information compiled in Fig. 1.

Nectaris melt in situ? Although the Nectaris basin itself has experienced both basaltic infill and impact erosion, its original morphology is still recognizable. Small plains near inner basin ring massifs and inter-massif "draped" deposits were identified as remnants of the Nectaris basin impact melt sheet [12]. Using Clementine spectral data, Spudis [13] determined that the mean iron content of these impact-melt units is higher than Orientale (FeO=5.6 vs 4.6 wt.%), which suggests more mafic target material underlying Nectaris, as both basins are comparable in size and should have excavated to similar depths. However, the range of FeO within the Nectaris units is broad, suggesting regolith development over these units that has introduced non-melt components. No changes were observed near small craters that would suggest compositional variability with depth in these units.

We are revisiting these interesting exposures with other remote-sensing datasets. Comparisons of the composition of this unit with other known sample sites help constrain the Nectaris melt characteristic even further. It is hoped that through these combined approaches, we will be able to better recognize Nectaris impact melt and target it for detailed geochronology.

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Figure 2: Contributions from (top) ejecta and (bottom) impact melt of major basins to the Apollo 16 regolith.